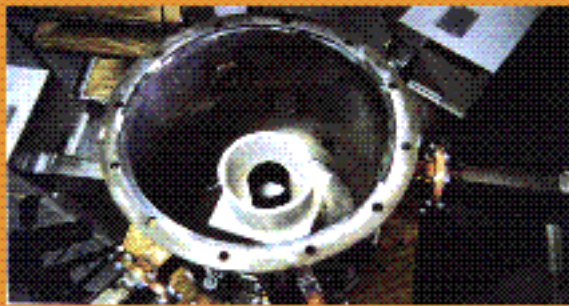




MICROWAVE CHEMICAL VAPOR INFILTRATION (MWCVI) PROCESS IMPROVES CERAMIC MATRIX COMPOSITE PARTS



Assembled microwave system (control box, cavity and six magnetrons).



Interior of the microwave cavity (four inch diameter, 6' long combustor can).

Payoff

The MWCVI process will enable the production of larger thickness ceramic matrix composite parts than are possible with conventional CVI methods. The process requires less raw material and less time for densification of the fiber preform resulting in a fabrication cost reduction of over 40%. The assembled microwave system, including the microwave cavity, six magnetrons and control box, is shown above.

Accomplishment

Under a Small Business Innovation Research (SBIR) Program, sponsored by Propulsion Directorate, the feasibility of microwave-assisted chemical vapor infiltration (MWCVI) for fabricating low cost ceramic matrix composite (CMC) parts was demonstrated. With MWCVI, process time is decreased from hundreds of hours to tens of hours, and material density is more

uniform. The amount of reactant gas needed is decreased significantly due to more efficient deposition of the gas on the fiber preform.

Background

The use of advanced CMCs has been plagued by the high cost of component materials and the long processing times required to densify the fiber preforms which results in high fabrication cost. In conventional CVI, the preform is heated from the outside so that the densification reaction occurs at the surface. The surface soon plugs up so that no more reactant gas can get into the center of the preform; therefore, part thicknesses are limited. With microwaves, heat is generated internally so that densification occurs from the inside outward toward the surface making thicker parts possible. Under the Ceramic Composite Combustor Cans for Expendable Turbine Engines SBIR program, Ceramic Composites, Inc. was able to demonstrate several payoffs from using MWCVI technology over conventional CVI such as more uniform part density, decreased processing time, reduced amounts of raw material needed and significant cost savings. Also, because the matrix precursor is deposited on the preform more efficiently, so that less of it is wasted, MWCVI is a much more environmentally friendly process.